

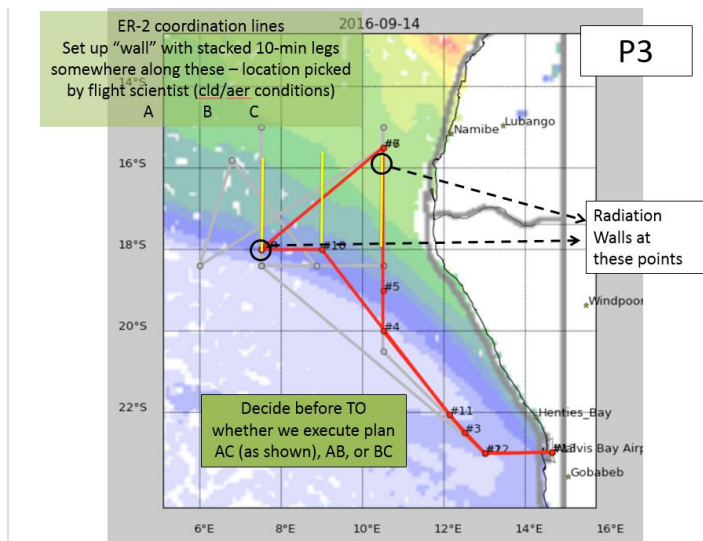
Flight report – P-3 ORACLES, Sep 14, 2016

Submitted by Jens Redemann (P-3 Flight scientist); Assistant Flight Scientist: Sarah Doherty (P3)

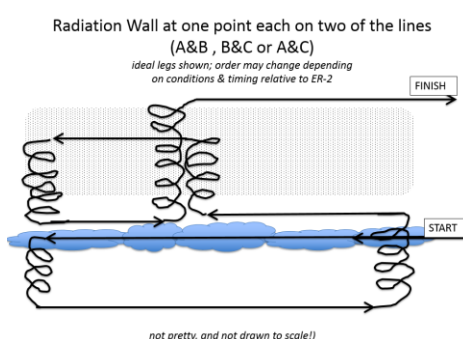
Ground Mission Scientists: Sebastian Schmidt (P3), Rich Ferrare (ER2)

Goals/Objectives:

1. ER-2 takeoff: 9:00am local P3 takeoff: 9:45-10:00am local
2. Target was radiation walls at two points with contrasting cloud/aerosol conditions
3. Over-flights of P3 by ER2 at least once, and nominally twice, during each radiation wall.
4. ER2 will fly south-north-south along two of three lines (AB, BC, or AC); two lines to be selected early on day of flight, depending on actual cloud conditions (looking for contrasting cloud fractions/albedos)

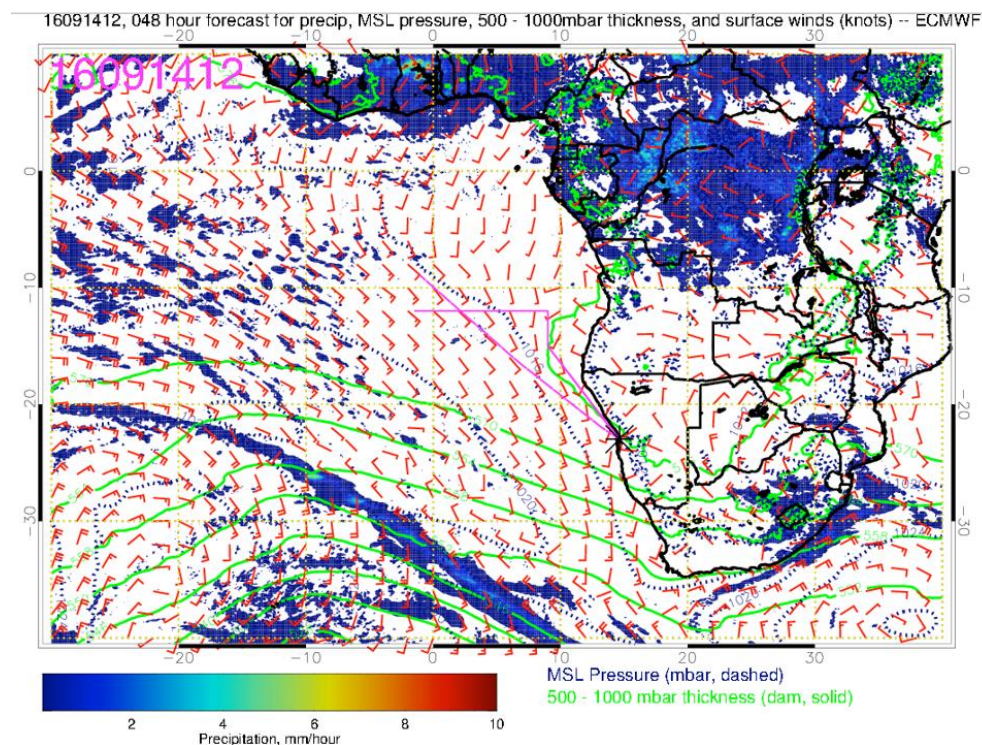


5. A point will be selected on each of these lines where the P3 will do a radiation wall. Decision on the points will be made in-flight.
6. An **example** of the possible walls/spirals on the radiation walls shown below.



Forecasts:

Through Thursday, pressure gradient (sfc) weakens, with less subsidence and less low cloud clearing near the coast.



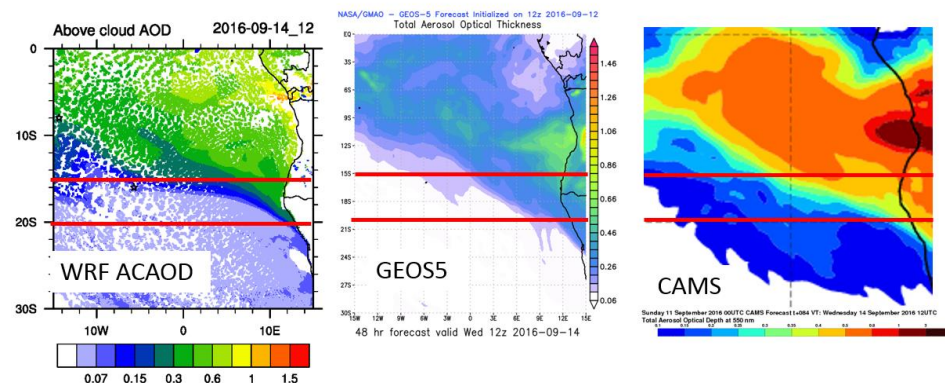
Wednesday:
Pressure gradients
weaken as front
approaches.

4

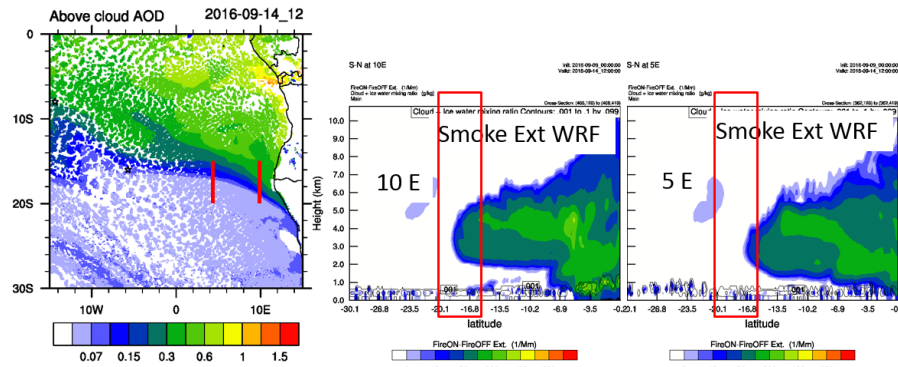
Influence of frontal passage on Thursday (9/15) and Friday (9/16) – possible weak crosswinds on landing and greater ceiling issues on Thursday. This is a strong spring storm, and there are significant changes in the low level circulation forecast. High cloud is reduced as upper level trough has moved east, replaced by upper level anticyclone over SE Atlantic. This starts to break up at end of fcst period (Friday and Saturday – but high clouds still minimal on Friday). Middle clouds waning through the week and should be much less of a problem through the forecast period.

Aerosol Forecast:

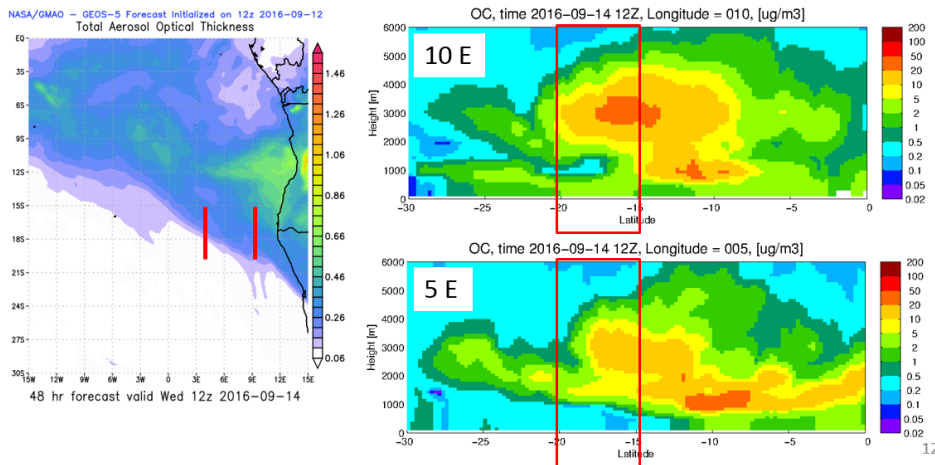
AOD 12 UTC



Vertical cross-section South to North



GEOS5 OC curtains



General Remarks:

P3 take-off: 07:59UT

P3 landing: 15:54UT

Duration (recorded): 8.1hrs

Lines A&B were picked in weather briefing as the likeliest to provide lack of mid-level clouds and some contrast in cloud albedo. Point for coordination between aircraft along B leg (9E) was chosen after take-off to be near 17.5S (two ER-2 over-flights). Point for coordination between aircraft along A leg (7.5E) was chosen after take-off to be near 16.15S (3 ER-2 over-flights). Actual coordination work was complicated due to some miscalculations of ER-2 arrival times at coordination points. Nonetheless, the P-3 was at most relevant point within radiation wall during ER-2 overpasses of both N-S legs. Full square radiation spiral on leg A. Good preliminary results, indicating significant albedo differences within spiral. Specific horizontal legs during radiation walls as shown in Figure 3a&b.

Figure 1. Actual ER-2 (blue) and P-3 flight track (green) for 14 Sep 2016.

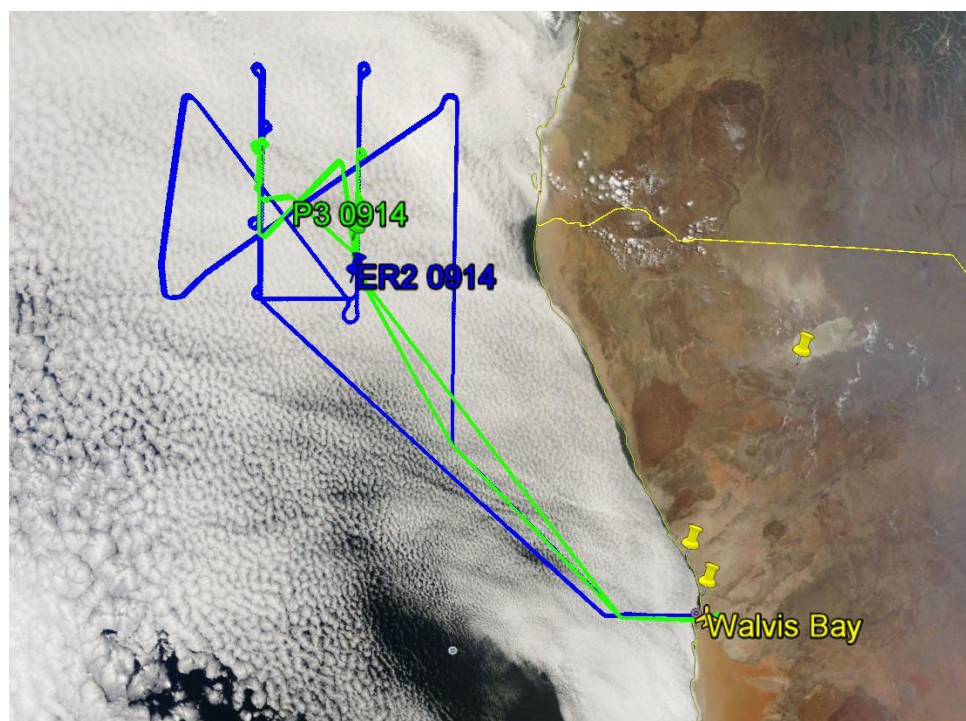
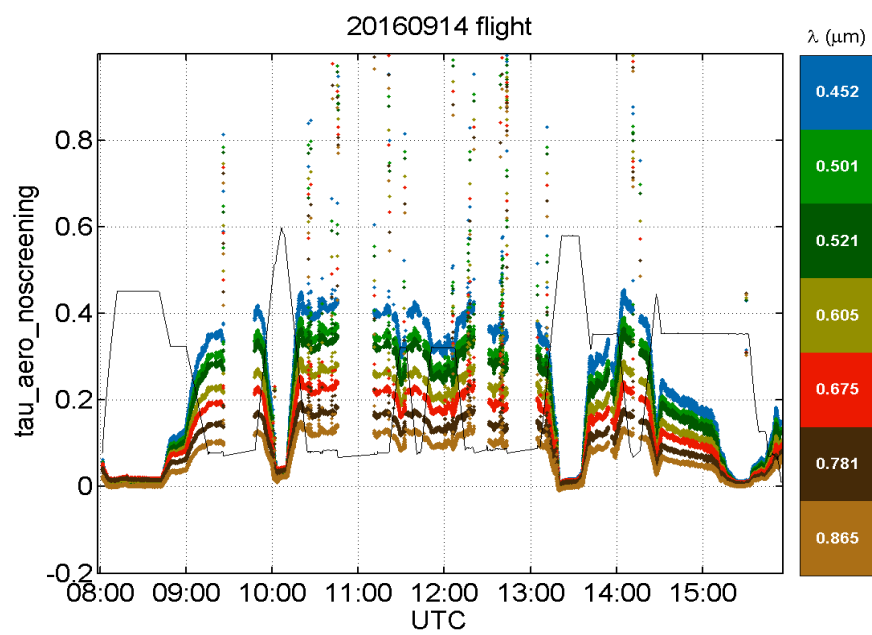
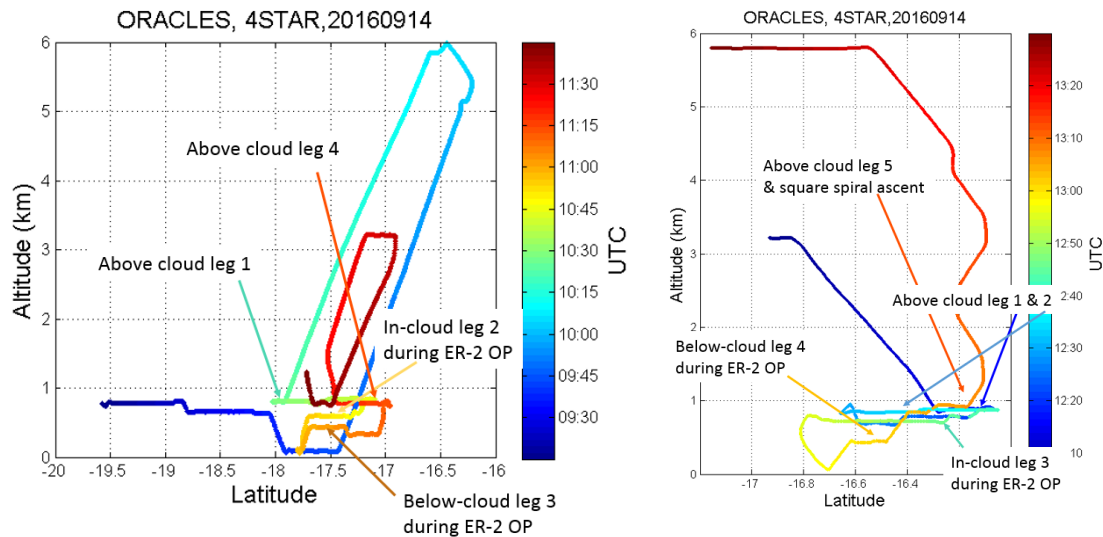


Figure 2. Preliminary 4STAR AOD and flight altitude



star20160914flighttau_aero_noscreeningseriesVISonly.fig, ORACLESstarbasicplots.m, QIn, 2016-09-14

Figure 3a Horizontal legs during radiation wall on leg B; 3b Horizontal legs during radiation wall on leg A



Progress towards Science Objectives: expectation-based estimates need further analysis
green-success likely; red-success uncertain

Direct Forcing

SO1-1 evolution of BBA properties with transport: ~ 343 min 4STAR sun tracking
SO1-2 spectral radiative fluxes ~ 122 mins (0.6km<alt<1.8km, sun visible)
SO1-3 factors that control seasonal variation of aerosol ~ 343 min 4STAR sun tracking

Semi-Direct Effect

SO2-1 relative aerosol-cloud vertical structure ~8 profiles from altitude>3km to cloud top
SO2-2 constrain aerosol heating rates ~122 mins (0.6km<alt<1.8km, sun visible)
SO2-3 cloud microphysics ~ at least 81 minutes in or below cloud (from 4STAR)

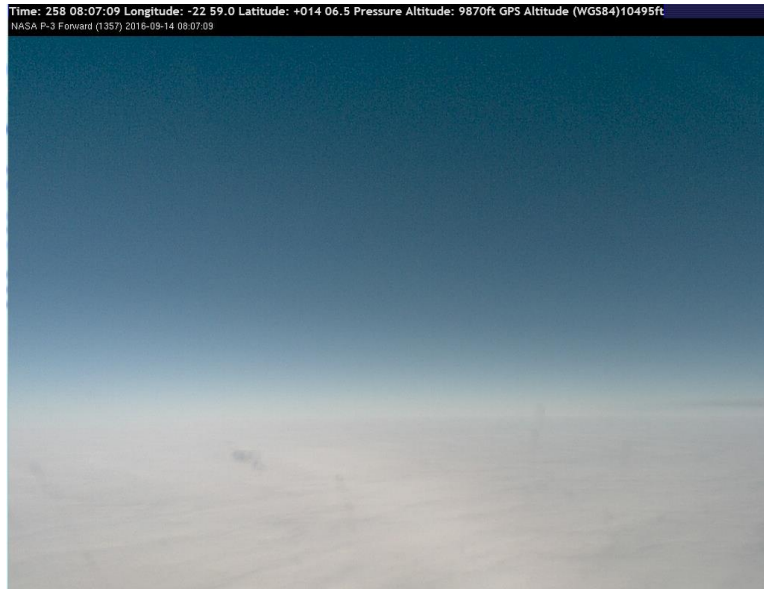
Indirect Effects

SO3-1 aerosol-BL mixing ~at least 81 minutes in or below cloud (from 4STAR)
SO3-2 aerosol-BLcloud microphysics* ~at least 81 minutes
SO3-3 precipitation susceptibility* ~at least 81 minutes

*does not include 0.5 hour spent in mid-level cloud

General Observations:

Figure 2. General cloud scene during transit to Nybek



8:35: going down to sample plume. 500ft/min to 10kft

8:44 found top of layer at 12.5kftore broken clouds



8:46 nadir camera shot shows broken clouds

Level leg at 10kft to 10:59

8:59 descending to cloud top

9:17 level at cloud top - cloud tops at 2.3kft, from this altitude (2.7kft) they appear homogeneous, but from 10kft they appeared like closed cells with maybe 80-90% cloud fraction

9:37 descending to 200ft for min alt leg 5-mi N, fairly calm ocean minimal white caps

10:15 after en route ascent, did 180, en route descent now, ETA of ER-2 was changed again, trying to maneuver

10:28 maneuvering for above cloud AOD run North and then return run South in cloud trying to reach coordination

Multiple attempts at coordination made very difficult by incorrect timing assessments for ER-2 arrival on location

Headed over to line A, worked point near 16.15S along the 7.5deg East longitude

Ultra-clean layers above cloud tops throughout coordinated maneuvers

13:58 end of leg on 060 heading (which was to look at AOD gradient in models)

Clouds fairly uniform

14:00 en route descent to cloud top (2.1kft), 2 min above cloud, 2 min below cloud, en route ascent

15:31 solid clouds during approach to WVB